Purpose: 90Y radioembolization is a promising treatment for unresectable hepatocellular carcinoma. A dose of 120 Gy is typically prescribed to a segment or lobe of the liver, but dose of 90Y in the liver tumor is highly heterogeneous. Recently developed 90Y PET/CT enables the visualization of the injected 90Y distribution with high resolution. The purpose of this study is to develop an integrated system to quantify 3D dose distribution using PET/CT images.

Methods: According to our institution’s protocol, 90Y PET/CT scan is acquired for each patient two hours after radioembolization. Based on the 90Y activity distribution from PET scans, we used a convolution method to calculate radiation dose with a published dose kernel for 90Y. The gross tumor volume (GTV) was retrospectively contoured by a clinician using contrast-enhanced diagnostic CTs. Because of breathing motion and different patient positions between the diagnostic CT and PET/CT, we manually registered these two CT scans by aligning 200 Gy dose line with the center of the intended treatment GTV.

Results: The system was integrated with a commercial RT PACS/Review station (MIMVista) through DICOM. The dose obtained was of the resolution of PET scans (2-4 mm). This distribution enables physicians to quantify treatment volume and dose relationships either through 3D dose distributions or dose volume histograms. For the five patients tested for our program, liver mean doses agree with clinical results within 5%. We were able to quantify radiation doses to 95% of GTV, and radiation dose received by the CTVs extended 5 mm from the GTV.

Conclusions: The system is easy to use for radiation oncologists. With this system, clinicians can quantitatively evaluate delivered dose of 90Y treatment in high resolution.

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No conflict of interest for this work.